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Abstract

Title of Document: "Friction Stir Welding of additive manufactured Ti-6Al-4V alloy sheets: Mechanical and Microstructure characterization"

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Abstract

Friction stir welding (FSW) is a novel technique which exhibits several advantages in welding titanium and its alloys as compared to other joining techniques. FSW was conducted on 3mm thick electron beam melted (EBM) titanium alloy Ti-6Al-4V sheets using WC-10% Co alloy tool. The experiments were carried out at a constant traverse speed of 45mm/min for various rotational speeds of 400, 500 and 700rpm. Defect-free welds were obtained for rotational speeds of 500 and 700rpm. Optical microscopy and scanning electron microscopy were used for microstructure analysis. Microstructures for all the welds revealed the fully lamellar α+β morphology in SZ having β phase at grain boundaries and refined equiaxed grains in the top and bottom region of the welds. Energy dispersive spectroscopy (EDS) and X-ray diffraction (XRD) were carried out to confirm the presence of tool wear debris and secondary phases in the welds. Tool wear debris was found in the welds near the top surface of the welds with the absence of any secondary phases. Hardness tests showed large fluctuation in the weld made at 400rpm, while hardness for other welds made at different rotational speed is in agreement with the corresponding grain size. All the joints failed from

the stirred zone (SZ) during the transverse tensile testing. Both elongation and tensile strength were found to be lower than base material for all the joints. Fractography analysis of fractured tensile tests was done using the scanning electron microscopy.

Keywords: Friction Stir welding, Ti-6Al-4V alloy, Electron beam melting, lamellar microstructure, mechanical properties